

## ANTIMICROBIAL RESISTANCE: MECHANISMS, CLINICAL CHALLENGES, AND EMERGING THERAPEUTIC STRATEGIES

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### ABSTRACT

Antimicrobial resistance (AMR) has become one of the toughest menaces to the overall health of people worldwide, undermining the effect of life-saving antibiotics and making it more difficult to clinically treat infectious diseases. The range of resistance mechanisms deployed by bacteria includes intrinsic, acquired, and adaptive mechanisms through degradation of the targets with enzymes, modification of targets, lowering of membrane permeability, and active efflux. These mechanisms are clinically demonstrated in such major pathogens as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), carbapenem-resistant *Acinetobacter baumannii* (CRAB), and the extended spectrum  $\beta$ -lactamase (ESBL)-producing Enterobacteriaceae. Such organisms highlight the need to implement novel therapeutic interventions urgently. However, new antibiotics (e.g., teixobactin, lefamulin, cefiderocol), bacteriophage-based therapies, engineered lysins, immune-modulatory agents, antibody-derived therapeutics, and nanotechnology-based antimicrobials are all recent developments. The therapeutic potential of the existing drugs is further enhanced by combination regimens and efflux pump inhibitors. This review outlines existing knowledge on bacterial resistance mechanisms and new treatment plans, with the crucial need of the world to be responsible in terms of stewardship, continuous innovation, and concerted effort to reduce AMR and maintain therapeutic effectiveness in the future.

**KEYWORDS:** Antimicrobial Resistance (AMR), Resistance Mechanisms, Multidrug-Resistant Pathogens, Novel Therapeutics, Antibiotic Stewardship, Infectious Disease Treatment

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